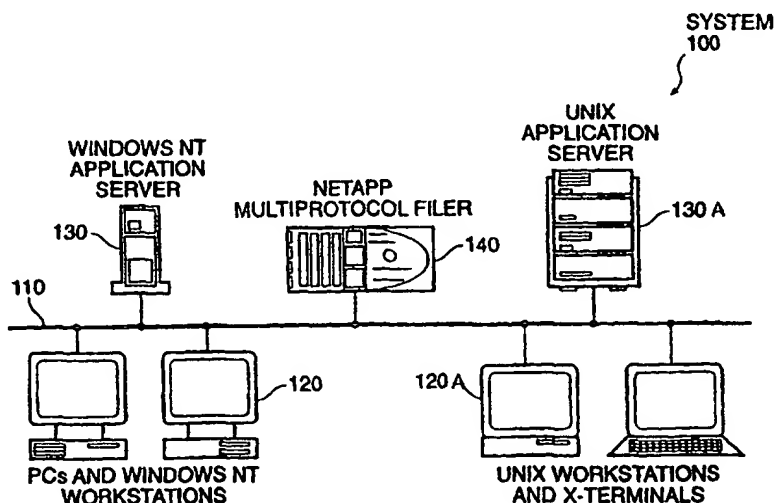


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(21) International Application Number: PCT/US99/13784 (22) International Filing Date: 17 June 1999 (17.06.99) (30) Priority Data: 09/099,844 19 June 1998 (19.06.98) US (71) Applicant: NETWORK APPLIANCE, INC. [US/US]; 2770 San Tomas Expressway, Santa Clara, CA 95051 (US). (72) Inventor: MUHLESTEIN, Mark; 15105 Venetian Way, Morgan Hill, CA 95037 (US). (74) Agent: SWERNOFSKY, Steven, A.; Swernofsky Law Group, P.O. Box 390013, Mountain View, CA 94039-0013 (US).		(81) Designated States: CA, CN, JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>With amended claims and statement.</i> Date of publication of the amended claims and statement: 3 February 2000 (03.02.00) <div style="text-align: right;">RECEIVED FEB 15 2000 SWERNOFSKY LAW GROUP</div>

(54) Title: BACKUP AND RESTORE FOR HETEROGENEOUS FILE SERVER ENVIRONMENT**(57) Abstract**

The invention provides a file server that provides for backup and restore of files in a heterogeneous file server environment. Metadata associated with each file by each model or protocol is preserved across backup and restore operations. The file server performs at least three tasks as part of the backup and restore operations. The file server notes all file attributes associated with each file in either model. These file attributes can include Unix perms, ownership and timestamp information, and link information. On backup, the file server records those file attributes in an analogous record using a different model. The file server records each element of Unix metadata as an NT Extended Attribute for use by an NT backup element. On restore, the file server restores those file attributes from the analogous record. The NT Extended Attributes provided by an NT restore element are translated into Unix metadata. The file server provides an element for translating between Unix metadata and NT Extended Attributes transparently to the NT backup and restore elements, so that NT backup and restore elements that were created without reference to the heterogeneous file server environment can be used.

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[received by the International Bureau on 17 December 1999 (17.12.99);
original claims 1 and 10 amended; remaining claims unchanged (2 pages)]

1. A file server,
said file server disposed for recording and retrieving each one of a set of files
5 in one of a plurality of data storage and retrieval models;
each one of said data storage and retrieval models disposed for including
metadata with at least some of said files;
said file server including a backup element disposed for preserving all of said
metadata for retrieval associated with said files even when said files are recorded by said
10 backup element in one of said data storage and retrieval models other than associated with
said files.
2. A file server as in claim 1, wherein said backup element records said
metadata as an NT Extended Attribute for use by an NT backup element.
- 15 3. A file server as in claim 1, wherein said backup element records said
metadata in an analogous record using a data storage and retrieval model other than
associated with said files.
- 20 4. A file server as in claim 1, wherein said data storage and retrieval
models include Unix/NFS and NT/CIFS.
5. A file server as in claim 1, wherein said file server includes an
element disposed for translating between Unix metadata and NT Extended Attributes
25 transparently to a set of NT backup and restore elements.
6. file server as in claim 1, wherein said metadata includes at least one
of
30 Unix permission bits;
ownership or group identifiers;
timestamp information; and
file link information.
- 35 7. A file server as in claim 1, wherein said metadata includes file link
information; and said backup element distinguishes between hard links and symbolic links.

8. A file server as in claim 1,
including a restore element disposed for recovering said metadata associated
with said files even when said files are recorded by said backup element in one of said data
storage and retrieval models other than associated with said files;
5 wherein said restore element retrieves said metadata from said analogous
record and records said metadata using a data storage and retrieval model associated with
said files.
9. A file server as in claim 8, wherein said metadata includes file link
10 information; and
said restore element maintains connectivity specified by hard links in said set
of files.
10. A method of operating a file server, said method including steps for
15 recording and retrieving each one of a set of files in one of a plurality of data
storage and retrieval models;
including metadata with at least some of said files in each of said data storage
and retrieval models;
performing a backup operation, including steps for preserving all of said
20 metadata for retrieval associated with said files even when said files are recorded by said
backup element in one of said data storage and retrieval models other than associated with
said files.
11. A method as in claim 10, including steps for maintaining connectivity
25 specified by hard links in said set of files.
12. A method as in claim 10, including steps for recovering said metadata
associated with said files even when said files are recorded by said backup element in one of
said data storage and retrieval models other than associated with said files;
30 wherein said steps for recovering include steps for retrieving said metadata
from said analogous record, and steps for recording said metadata using a data storage and
retrieval model associated with said files.

8. A file server as in claim 1,
including a restore element disposed for recovering said metadata associated with said files even when said files are recorded by said backup element in one of said data storage and retrieval models other than associated with said files;
- 5 wherein said restore element retrieves said metadata from said analogous record and records said metadata using a data storage and retrieval model associated with said files.
9. A file server as in claim 8, wherein said metadata includes file link
10 information; and
said restore element maintains connectivity specified by hard links in said set of files.
10. A method of operating a file server, said method including steps for
15 recording and retrieving each one of a set of files in one of a plurality of data storage and retrieval models;
including metadata with at least some of said files in each of said data storage and retrieval models;
performing a backup operation, including steps for preserving all of said
20 metadata for retrieval associated with said files even when said files are recorded by said backup element in one of said data storage and retrieval models other than associated with said files.
11. A method as in claim 10, including steps for maintaining connectivity
25 specified by hard links in said set of files.
12. A method as in claim 10, including steps for recovering said metadata associated with said files even when said files are recorded by said backup element in one of said data storage and retrieval models other than associated with said files;
- 30 wherein said steps for recovering include steps for retrieving said metadata from said analogous record, and steps for recording said metadata using a data storage and retrieval model associated with said files.

STATEMENT UNDER ARTICLE 19

Independent claims 1 and 10 have been amended to clarify that all metadata
5 associated with a particular file is preserved during conversion as part of the backup and
restore operations across the differing storage and retrieval models.

The IBM reference, "Mapping the VM text files to the AIX text files," IBM
Technical Disclosure Bulletin, vol. 33, no. 2, July 1990 (1990-07), page 341, discloses a
10 simple scheme for porting text files between VM and AIX, both IBM operating systems, not
backup and recovery operations.

Even in the illustrated porting scheme, not all of the VM metadata is preserved
during the mapping procedure. The scheme accounts for preserving the file name (FN),
15 mode (FM), and type (FT), but not for preserving the VM file record length.

Furthermore, VM systems commonly use NFS as the file server protocol for backup
and recovery operations, as do AIX systems. A combination of two operating systems
using the same file server protocol does not constitute a heterogeneous file server
20 environment.

Accordingly, the claims as amended represent an inventive step over the cited art.